

# KC-390 Certification Process, EIS – Entry Into Service

Daniel Rondon Pleffken

National Institute for Space Research, Av. dos Astronautas, 1758, Jardim da Granja, São José dos Campos - SP – Brazil.

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**Abstract-** This work contextualizes the certification and its importance in the international scenario for military aeronautical products. It presents a brief summary of the Military Airworthiness Certification process in Brazil for aircraft that do not have a Type Certificate, which is applied to projects under development. For this, the work: reviews and analyzes the Brazilian context; identifies the Special Initial Flight Permit process of the Brazilian military aeronautical industry; and exemplifies its application in the (Entry Into Service) KC-390 airworthiness certification process. At the end of the work, it was possible to understand the processes used and their patterns. In addition, the practices adopted can serve as benchmarking for applications in other contexts.

## I. INTRODUCTION

The certification activity, that is, an independent assessment of the conformity of aeronautical products by third party, obliges aircraft and their components manufacturers to incorporate quality mechanisms in all phases of their projects with the main objective of preventing the recurrence of accidents caused by design failures. In addition, certification contributes to the military aeronautical industry obtaining high levels of confidence, using elaborated tools to mitigate security problems however, aiming the military mission accomplishment for which the design was developed [6].

The KC-390 is the largest military aircraft developed, manufactured and in the process of military certification in the Southern Hemisphere. It has the capacity to carry out missions of Logistic Air Transportation, Refueling in Flight (REVO), Aeromedical Evacuation, Search and Rescue, Combat Fire in Flight, among others. The KC-390 was developed to meet the operational requirements of the Brazilian Air Force, providing strategic mobility to the Brazilian Defense Forces.

The Brazilian Aeronautical Command Certification Authority is defined as the Department of Aerospace Science and Technology (DCTA) for the space, aeronautical and defense sectors. The body that performs

product / project certification activities and quality management systems related to the aerospace sector is IFI, Institute for Fostering and Industrial Coordination and had the biggest challenge, in terms of certification, the KC-390.

This work presents the main characteristics of the airworthiness certification process for military aircraft that have their type certification process in progress. Exemplifying it in the KC-390 project.

## II. BRAZILIAN MILITARY TYPE CERTIFICATION PROCESS

A canonical certification process consists of 5 phases: **conceptual design, requirements definition, compliance demonstration planning, implementation, and post-certification.**

In the **conceptual design** phase, the developer establishes the conceptual design of the product that can be certified in the future. Together, the Certification Authority and the developer carry out interactions that allow the discussion of new technologies, materials, processes and other aspects relevant to the project. It is at this stage that the definition of the set of requirements that will constitute the Certification Basis (BC) begins.

In the **requirements definition** phase is when the process formally begins with the Certification Authority. The Certification Basis (BC) is refined and agreed between the developer (who, from this stage on, can also be called the applicant) and the certifier. The approval of this BC is an activity under the responsibility of the Certification Authority. Therefore, it cannot be delegated. The Certification Plan (PC), an agreed strategy for verifying requirements, and including management plans (how the process will be conducted), which begins to be defined at this point.

In the **planning** phase of the compliance demonstration, the Certification Authority assesses its involvement in the certification activities, based on risk factors and consolidating the plans that started to be discussed in the previous phase.

In the fourth phase, of **implementation**, the activities agreed in the Specific Certification Plan are carried out, which consist of executing tests, whether in laboratories or in flight, compliance inspections, analyzes, among others.

Finally, the last phase, **post-certification**, consists of finalizing the documentation to record the activities carried out and future changes. This is also, where the Continued Airworthiness activities take place, which maintain the safe condition of the product, e.g. scheduled maintenance and inspections. In addition, before the product's Entry Into Service (EIS), its Operational Evaluation (AVOP) is carried out, a process by which the operational efficiency and operational suitability of a System or Material are evaluated [7].

It should be noted that the type certificate refers to the approved type design and the Airworthiness certificate refers to the product.

Once the aircraft has an approved type certificate, a conformity inspection is carried out in order to obtain the Initial Airworthiness Certification (CAI), which is issued by the IFI.

A variation of the model above is the Military Airworthiness Certification process in Brazil for aircraft that do not have a Type Certificate, which is applied to projects under development, entitled as Initial Special Flight Permit (PEVi); Applied in the case of the KC-390.

### III. KC-390 AIRWORTHINESS CERTIFICATION PROCESS – EIS

In September 2012, during the discussions on the conduct of the Military Type Certification process for the KC-390 aircraft, Embraer SA proposed to IFI to conduct this certification process through an accreditation of the company, called in Brazil as Accredited Design

Organization (OPC), following, as far as possible and appropriate, the model used by the European Aviation Safety Agency (EASA), which is described in Regulation Part 21 - Subpart J - DOA (Design Organization Approval).

This proposal aimed to implement in the company, at that time, limited to the KC-390 Project, a Design Guarantee System (SGP) capable of guaranteeing to IFI the effectiveness of activities to verify compliance with the requirements from the BC of the referred aircraft, when carried out by its SGP, In a way so IFI could delegate, in part or entirely (at its sole discretion), these activities to the company.

After seven years of development and application of the aforementioned SGP, IFI started to apply such method in the Certification of other Embraer Design, such as IU-50 (IX) and E-99M, breaking the paradigm of the model traditionally used in the certification of Brazilian aeronautical products. Thus, IFI and EMBRAER innovated by adapting the European model to the characteristics of Brazilian military aviation.

Through extensive evaluation, which included Process Audits at the Embraer units of Eugênio de Melo and Gavião Peixoto, and Monitoring the compliance demonstration with the Certification Basis Requirements of the applied Type Designs, the maturity of the company's SGP was considered as appropriate to Accreditation.

Thus, on December 16, 2019, after meeting the Legal Entities Accreditation Committee. Which is a recognition of the great effort made by both organizations was formally expressed, with the issuance of Certificate 001C2019 for Embraer SA, the first Accredited Design Organization (OPC) in Brazil.

The KC-390 Certification process goes through the 5 phases identified in this work.

The strategy was to have two certification processes, one at IFI [8], which takes care of the military version of the plane and the other in the Brazilian National Civil Aviation Agency ANAC, responsible for the certification of the civil part of the aircraft.

As a result, the KC-390 Certification Basis had a basic platform version [1], also known as Green, whose type certificate was issued in 2018 that includes requirements described in the following Brazilian Civil Aviation Regulations:

- RBAC 025 - Airworthiness requirements: transport category airplanes [2];
- RBAC 026 - Continued airworthiness and safety improvements for transport category airplanes [3];

- RBAC 034 - Requirements for fuel drainage and exhaust emissions from aircraft with turbine engines [4]; and
- RBAC 036 - Noise requirements for aircraft [5].

Moreover, being part of the Certification Basis, we have the so-called “Mission Accomplishment requirements”, which, in other words, are the military requirements that shall be certified by the IFI.

For the Compliance Demonstration Planning phase, the implementation of a methodology that enabled EMBRAER as an Accredited Project Organization (OPC) in 2019 was carried out. This, although already adopted worldwide by aviation regulatory agencies such as EASA, was innovative for Brazil.

In 2014, it was estimated that the KC-390 Certification Plan had more than 600 pages; and 624 requirements to be verified by IFI using as a guide MIL-HDBK-516, Airworthiness Certification Criteria the US Air Force (USAF). At the time, the Certification Plan had foreseen more than 47,000 man/hours of workforce to be applied on the certification process, mainly in the Implementation phase.

To complete this process, a Compliance Inspection was carried out for the issuance of the Special Initial Flight Permit and the technical basis equivalent to the type certificate was the issuance of a technical opinion by the Aerospace Products Certification Division at IFI, which describes the applicable requirements to the KC-390 EIS product.

The Post-Certification Phase started with the delivery of the first aircraft, which took place on September 4<sup>th</sup>, 2019. It deals, above all, with the field monitoring process for possible Service Difficulties arising from a failure linked to the aircraft design.

#### IV. PRACTICES ADOPTED TO SERVE AS BENCHMARKING FOR APPLICATIONS IN OTHER CONTEXTS

The military aeronautical industry has activities recognized for their technical commitment and credibility linked to safety and mission fulfillment, such as the KC-390 EIS Certification presented in this work. These activities have a high potential for application in the main technological products industries.

The **space**, medical, automobile and other industries, which deal with high-tech projects and have a specific development of qualification of new components and materials, live with the constant concern with the success of the project and the fulfillment of the mission. For this, it is important to adopt processes that guarantee the

fulfillment of the requirements, the conformity with the specifications and monitor the product life cycle. Although this is already being done on an increasing scale, it is suggested that those industries be inspired by the processes of the aeronautical industry, including those summarized in this work, adopting them as benchmarking and adapting to their needs and specificities.

#### V. CONCLUSION

This work first presented the military aeronautical certification process in the Brazilian context. Subsequently, the processes used by IFI (Brazilian military airworthiness authority) for the canonical certification were summarized, as well as the airworthiness certification

For aircraft that did not finalized their certification processes. It exemplified the stages of the certification process applied in the KC-390 - EIS (Enter Into Service). Finally, it was possible to understand the processes, practices, civil and military standards used by the industry in question. When summarizing the certification process, it is possible to evidence practices adopted to serve as benchmarking for applications in other contexts.

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